

What Is Claimed Is:

- 1        1. A method of manufacturing a micro-electromechanical  
2        device comprising the steps of:  
3                forming a moving member on a first substrate such that a  
4                first sacrificial layer is disposed between the moving member  
5                and the substrate;  
6                encapsulating the moving member, including the first  
7                sacrificial layer, with a second sacrificial layer;  
8                coating the second sacrificial layer with a first film  
9                formed of a material that establishes an hermetic seal with  
10               the substrate; and  
11               removing the first and second sacrificial layers.
- 1        2. The method of claim 1, further comprising the step of  
2               forming an opening in the first film prior to removing the  
3               first and second sacrificial layers.
- 1        3. The method of claim 2, wherein said opening forming  
2               step is performed during said coating step.
- 1        4. The method of claim 2, wherein said opening forming  
2               step is performed after said coating step.
- 1        5. The method of claim 2, further comprising the step of  
2               sealing the opening after the first and second sacrificial  
3               layers are removed.

1           6. The method of claim 5, wherein said sealing step is  
2           performed by coating the first film with a second film formed  
3           of the same material as the first film.

1           7. The method of claim 2, wherein said step of removing  
2           the first and second sacrificial layers includes the step of  
3           immersing the switch in one of a reactive liquid solution, a  
4           reactive gas, and a supercritical fluid.

1           8. The method of claim 1, further comprising the step of  
2           forming a conductive layer on the first film.

1           9. The method of claim 8, further comprising the step of  
2           coating the conductive layer with a second film such that the  
3           conductive layer is disposed between the first and second  
4           films.

1           10. The method of claim 9, wherein the second film is the  
2           same material as the first film.

1           11. The method of claim 8, further comprising the step of  
2           connecting the conductive layer with a second circuit that  
3           causes the conductive layer to act as a counter electrode.

1           12. The method of claim 1, wherein the miniature  
2           electromechanical device is formed on a substrate with other  
3           circuit components and the first film covers only the  
4           electromechanical device.

1           13. The method of claim 1, further comprising the step of  
2           mounting the first substrate on a second substrate carrying  
3           other circuit components.

1           14. The method of claim 5, further comprising the step of  
2           coating the movable member with an anti-stiction film prior to  
3           said sealing step.

1           15. The method of claim 1, wherein a plurality of  
2           microelectromechanical devices are formed on the first  
3           substrate and encapsulated by the first film, and further  
4           comprising the step of cutting the substrate to separate the  
5           microelectromechanical devices.

1           16. A micro-electromechanical system (MEMS) device  
2           comprising:  
3            a first substrate;  
4            a first control circuit formed on said first substrate and  
5            including a first actuation element;  
6            a movable member formed on said first substrate in spaced  
7            relation to said first actuation element, said movable member

8                   being electrically conductive and movable in the direction of  
9                   said first actuation element; and

10                  a helmet defining a hermetically sealed chamber around  
11                  said movable member, said helmet being formed by removing a  
12                  sacrificial layer between said movable member and said helmet.

1                  17. The MEMS device of claim 16, and further comprising an  
2                  inert gas disposed within said hermetically sealed chamber.

1                  18. The MEMS device of claim 16, and further comprising a  
2                  second control circuit with an actuator element disposed  
3                  within said helmet.

1                  19. The MEMS device of claim 16, and further comprising a  
2                  plurality of moving members formed on said substrate, wherein  
3                  said helmet defines a plurality of hermetically sealed  
4                  chambers around said movable members.

1                  20.       The MEMS device of claim 16, wherein said helmet is  
2                  formed of a silicon oxynitride film.

1                  21.       The MEMS device of claim 16, wherein said helmet has  
2                  tapered sides.

1                  22. A method of fabricating a micro-electromechanical  
2                  system (MEMS) device comprising the steps of:

3 forming a control circuit with an actuating element on a  
4 substrate;

5 defining a movable member above the actuating element by  
6 applying a first sacrificial layer over the actuating element,  
7 depositing a conductive material such that the material  
8 extends from the circuit to cover the first sacrificial layer,  
9 and removing portions of the sacrificial layer around the  
10 movable member but not between the moving member and the  
11 substrate;

12 encapsulating the moving member on all sides with a second  
13 sacrificial layer;

14 coating the second sacrificial layer with a material that  
15 forms an hermetic seal with the substrate; and  
16 removing the first and second sacrificial layers.

1 23. The method of claim 22, wherein said step of applying  
2 a first sacrificial layer includes tapering edges of the first  
3 sacrificial layer.

1 24. The method of claim 23, wherein said step of applying  
2 a second sacrificial layer includes tapering edges of the  
3 second sacrificial layer.

1 25. The method of claim 24, wherein said tapering step  
2 includes baking the first and second sacrificial layers after  
3 curing.